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CENTS

SHOP SYSTEMS

FOUR TYPICAL SHOP SYSTEMS USED IN REPRESENTATIVE MACHINE BUILDING PLANTS

2 DAILY TIME CARD.

Date 2/13/11

Employe's No. 156 Name J. Brown

Order No.	Part No.	TIME	Description	Rate	C.	
1543	14	1	Finishing Studs	30		30
1622	8	3	Facing Castings	30		90
1567	21	6	Turning Cranks	30	1	80
Order No.	**Part No.**	**Weight**	**Material Only**		**Cost**	
1543	14	20	C.R. Shafting	4		80
1622	8	56	Cast Iron	3	1	68
1567	26	415	Forgings	18	74	70

Approved by Williams Foreman.

R Sup't.

MACHINERY

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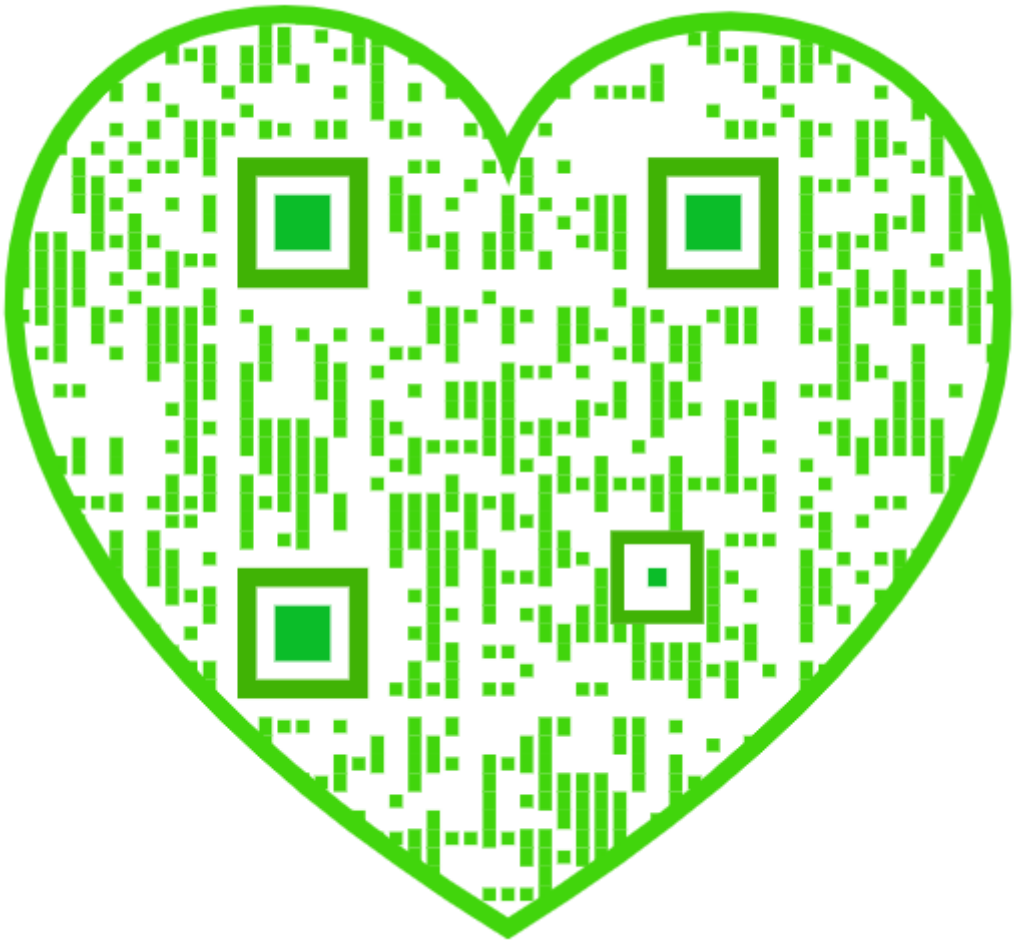

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NUMBER 139

SHOP SYSTEMS

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UNIV. OF CALIFORNIA

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PREFACE

There are practically as many shop systems in use as there are shops or factories; because in every shop there are some conditions peculiar to that shop, which cannot be covered by any system of universal application. There are, however, certain fundamental principles that must be embodied in all shop systems, and these can be best explained by describing in detail a number of systems that have been successfully applied in practice. The systems outlined in this Reference Book have proved their value in the manufacturing establishments where they are used. They may not apply directly to the conditions in other plants; certain details may have to be changed and some of the forms modified; but the general outlines can be followed, and will prove of value to those who have to devise new systems or are endeavoring to improve old ones.

CHAPTER I

GENERAL SHOP SYSTEM

Much has been said in technical books and magazines regarding shop systems, but many of these systems are cumbersome, and show a tendency towards "red tape." In the following a system is outlined that is anything but elaborate, being compact and concise, inasmuch as it puts all information regarding the affairs of the works under the complete control of the works superintendent. It makes him entirely independent of the various heads of departments in determining the progress of all work through these departments, and enables him at a glance to stop or push such work as is important

FACTORY COST.

MACHINE NO. 126 STYLE P Issued to Dep't's No. 1-2-3-4-5-9

Order No	No. Fin.	Material	Department Costs 1	2	3	4	5	6	7	8	9	10	11	12	15	P	D	Total Cost		Average Cost	
1567	24	123.98									10.40					1.92	4.60	18.56	58	77	36
1745	24	119.64									2.80							18.29	61	76	24
1854	12	65.79									1.44							9.81	65	81	81

Fig. 1. Superintendent's Office Reference and Record Card of Machine Costs

or is wanted in a hurry. At the same time it gives him an authentic record of all facts pertaining to the cost of material and labor, and other particulars of equal importance. Not only that, but in case of emergency, it assures a promise of any special delivery, rush order, etc., with an accuracy that cannot be denied.

The fundamental principle of the system is not building the completed machine as a unit, but building the machine by the part. Considering that in most manufacturing establishments, the machines are standardized and fully detailed with complete drawings of all parts, this can readily be accomplished, and means the grouping together of the equipment in batteries best suited to handle the work along these lines without any undue shifting around of material, keeping it in the correct rotation from department to department in succession until finally brought to the assembly. To do this the following departments known by number have been established in

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one machine building plant, where the system described is used:

D Drafting-room;
P Pattern shop;
1 Planer, boring mills and large radials;
2 Lathe;
3 Milling machine;
4 Shaper and drill press;
5 Tool and die making;
6 Grinding;
7 Experimental;
8 Small part assembly;
9, 10, 11, and 12 Assembly;
13 Miscellaneous.

The assembly departments, 8 to 12 inclusive, are equipped with the necessary small machine tools.

FACTORY COST.

PART NO. 26 No. required each machine 1 Order issued to Dep'ts No. 2-3-4-9
For Machine No. 126 Style P

Order No.	No. Fin.	Material	Department Costs 1	2	3	4	5	6	7	8	9	10	11	12	13	P	D	Total Cost		Average Cost	
1567	24	149.40		18.45	9.65	15.44												197	87	8	25
1745	24	150.94		16.30	19.56	14.90												201	70	8	41
1854	12	80.34		9.45	10.30	6.47												106	56	8	88

Fig. 2. Superintendent's Office Reference and Record Card of Parts Costs

The mode of procedure is as follows: The sales department issues its order to the superintendent in the customary manner for a given number of machines of a certain type; all machines are known by number. The superintendent then secures from the drafting department a complete set of blueprints showing all the details, and from which the orders calling for these parts are issued to the various departments.

The following is a list of blanks and cards used, and which are herewith illustrated:

Fig. 1. Superintendent's office reference and record card of machine costs.

Fig. 2. Superintendent's office reference and record card of parts costs.

Fig. 3. Requisition blank.

Fig. 4. Superintendent's office stock advice ticket.

Fig. 5. Identification tag.
Fig. 6. Department shop order.
Fig. 7. Department partial shop order ticket.
Fig. 8. Daily time ticket.

When the superintendent receives the order for the machines, he will cause the order number to be recorded on a card like that in Fig. 1; eventually this card will contain a full record of all costs of the machine; it is known as the "Machine Factory Cost," and is printed on blue paper so that it may be readily recognized. This card is ruled into columns, and will contain, as before stated, all factory particulars, including the number finished, cost of material, cost of every department that has any work in connection with same, and finally the total cost of the order and the individual cost of each

REQUISITION FOR MATERIAL.

To Store Keeper, Date 2/13/11.

Please deliver the following supplies,

Quantity	Patt. No.	Part No.	Mach. No.	Order No.		
24	P16	16	126-P	1567		
24	P4	4	"	"		
24	forging	26	"	"		
48	P24	24	"	"		

Williams Foreman.

Department No. 2

Fig. 8. Requisition Blank

machine. Each successive order is recorded on this card, and a ready comparison of the fluctuations in operating expenses for departments are immediately noted for investigation with a view to ascertaining the causes.

The parts of each machine are numbered in rotation, and a separate record, as in Fig. 2, printed on yellow paper is kept of each in connection with the blue card above. This "Parts" card will eventually contain a full record of departments that handle the part, its weight, cost of material, costs of each department, and also the total and individual or average cost per part. Each successive order is recorded the same as on the card above, and the loop-holes in manufacturing due to negligence on the part of foreman or operator are immediately shown by the comparison of costs of labor, etc., in each department.

The large and heavy castings that represent the main parts of the machine are never kept in stock, and so are provided for immediately

by the superintendent on a requisition blank like that in Fig. 3, sent to the purchasing department. These blanks are made up in book form, four on a page; they have perforated edges, and are made in duplicate, the copy remaining in the book as a part of the superintendent's record.

For the smaller parts or castings, the superintendent causes the list shown in Fig. 4 to be sent to the store-keeper. This list, which is printed on heavy flexible paper, and put up in pad form, gives all particulars, and asks for the information indicated. The store-keeper, on receiving it, ascertains the number of parts or castings he has on hand as requested, fills in the date, signs his name or initials, and returns the list immediately to the superintendent's office. Upon the advice thus received, the balance of supplies, if any, are immediately ordered by the superintendent through the purchasing department, using the blank before described, Fig. 3. By adopting this plan, a check is kept on all castings and supplies, which prevents the continual accumulation of such supplies, a condition that would occur if they were ordered on each successive order without first ascertaining whether or not any stock was available.

STOCK ADVICE TICKET.

Date 2/10/11

To Store Keeper,

Please advise Superintendent's Office without delay, regarding the following Castings and Supplies for MACHINE NO. 126 STYLE P

Quantity	From Pat. No.	On Hand	Signature of Store Keeper
24	P-10	24	
24	P-11	16	
48	P-14	24	
48	P-16	32	
24	P-20	10	
24	P-28	24	
24	P-32	0	
24	P-34	0	
48	P-42	12	
			Date 2/11/11.

Sup't.

Return to Superintendent's Office.

Fig. 4. Superintendent's Office Stock Advice Ticket

The parts being all provided for through the superintendent's office, department shop orders, Fig. 6, are now issued to the various departments for all the parts to make up the completed machines. These orders have the number of the department printed in heavy black type in the upper left hand corner, and are printed on flexible paper (preferably white), so that they may be typed in multiple, to include all the departments handling or machining that particular part. As illustrative of its operation, an order is issued for 25 crankshafts for a certain style of press; orders are issued to departments 2, 3, 4, and 9. The lathe department No. 2 handles the work at the beginning; the milling department, No. 3, handles it after No. 2; and so on. Similar orders are issued to the first three departments, the orders being distinguishable by the number representing the department printed in the upper left-hand corner as above stated. A separate order, similar to the others, calling for the number of the complete machines, is

issued to department No. 9, the assembly department of this type of machine. Consequently all parts machined eventually find their way to the assembly.

Upon the receipt of this order by the head of department No. 2, or the department that first handles it, a requistion on the store-keeper is issued on a blank similar to that shown in Fig. 3, for the number of forgings required to fill the order, and as these have been provided through the superintendent's office, they are sent as requested, having a red tag, as in Fig. 5, attached to one of the lot to identify them. This tag contains all particulars as to quantity, part number, machine and style, and order number. As the work is completed in this department, this same tag or a duplicate is attached to one of the crankshafts already machined, and sent to the next department handling the same, which in this case is No. 3. The same procedure applies in this department; the work is then sent to the next, which is No. 4, with the red tag still attached. This department, in turn, sends the shafts when finished to the final department, No. 9, which is the assembly. Should one of these crankshafts, by any mischance, be spoiled or incorrectly machined through an error on the part of some mechanic, this system compels the foreman of the department to report this fact immediately to the superintendent, thus causing an investigation to be made as to how it happened, whether through negligence or accident, and gives no opportunity for anyone to quietly scrap it without the full knowledge of the superintendent. As the work is finished in each department, the shafts are sent on, the head of department sending them to the head of the next department, who acknowledges their receipt by signing his name in the space provided on the department shop order, at the same time filling in the date. This compels the receiving foreman to verify the number of pieces so that it tallies with the number on the red tag, Fig. 5. After obtaining the signature of the next department foreman, the shop order is returned to the superintendent and is filed, until all departments having any handling of this part have turned in their shop orders. All labor being completed on the part, the costs are transferred to the factory cost ticket, Fig. 2, which is then a complete record of actual costs.

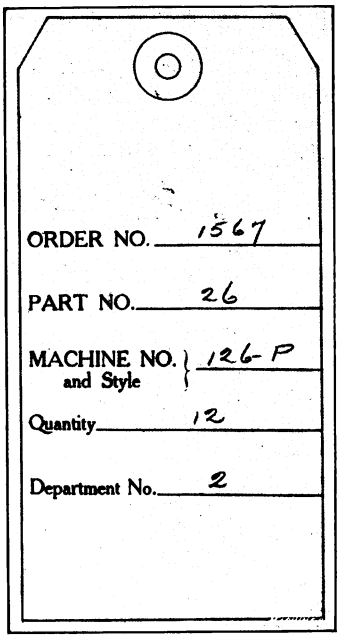
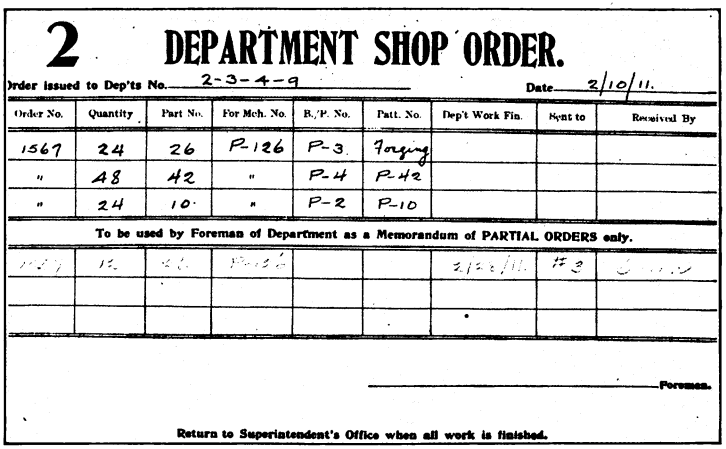


Fig. 5. Identification Tag

At various times, through the excessive rush of work and piling up of orders, it may be found to be good policy in some departments to

make up only a part of the order. To record this, another blank, Fig. 7, called the "Partial Order Ticket," printed on brown paper is used by the head of the department in lieu of the regular department shop order, and after going through the same routine as the original order, being signed by the foremen of the departments, is turned in to the



2 DEPARTMENT SHOP ORDER.

Order issued to Dep'ts No. 2-3-4-9 Date 2/10/11.

Order No.	Quantity	Part No.	For Mch. No.	B./P. No.	Patt. No.	Dep't Work Fin.	Sent to	Received By
1567	24	26	P-126	P-3	Forging			
"	48	42	"	P-4	P-42			
"	24	10	"	P-2	P-10			

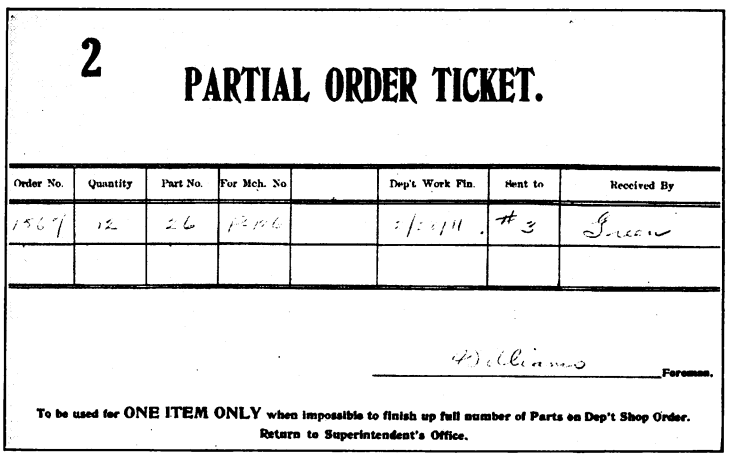
To be used by Foreman of Department as a Memorandum of PARTIAL ORDERS only.

1567	12	26	P-126			2/12/11.	#3	Green

Foreman.

Return to Superintendent's Office when all work is finished.

Fig. 6. Department Shop Order Ticket



2 PARTIAL ORDER TICKET.

Order No.	Quantity	Part No.	For Mch. No		Dep't Work Fin.	Sent to	Received By
1567	12	26	P-126		2/12/11.	#3	Green

Williams
Foreman.

To be used for ONE ITEM ONLY when impossible to finish up full number of Parts on Dep't Shop Order.
Return to Superintendent's Office.

Fig. 7. Department Partial Shop Order Ticket

superintendent's office. As this is done the fact is recorded on the original shop order in the space provided for this purpose; this acts as a constant memorandum of parts still due on the original order. Each department, in turn, on completion of the work to be done turns in a similar ticket to the superintendent; these are in pad form as issued to the heads of the departments. This partial order ticket, as it is turned into the superintendent's office, forms part of the record and shows what progress is being made on this particular part

through the works. The adoption of this plan enables the superintendent to take steps to push through and direct what parts are to be rushed, and avoids the holding up and delaying of parts in the various departments, for he has the information at hand to locate the part by looking up the department shop orders returned to his office.

A "Daily Time Ticket" as shown in Fig. 8, is an absolute necessity. It is ruled and printed, as shown, provision being made for all particulars of both stock and time; it also forms part of the superintendent's record. These are collected daily and filed in respective order number rotation, and upon completion of any department shop order, all information is transferred to factory cost cards as before

2 DAILY TIME CARD.

Date 2/13/11.

Employe's No. 156 Name J. Brown

Order No.	Part No.	TIME	Description	Rate	Cost	
1543	14	1	Finishing Studs	30		30
1622	8	3	Facing Castings	30		90
1567	26	6	Turning Crankshaft	30	1	80
Order No.	**Part No.**	**Weight**	**Material Only**		**Cost**	
1543	14	20	C.R. Shafting	4		80
1622	8	56	Cast Iron	3	1	68
1567	26	415	Forgings	18	74	70

Approved by R Sup't. Williams Foreman.

Fig. 8. Daily Time Ticket

described. This daily time ticket is an important factor in determining actual costs, etc.

To sum up, a system such as this one is automatic in operation, and has much to commend it: First, there is a complete and actual record of labor costs by departments; second, a constant check is kept of costs by comparison, and a means provided for locating any excessive expenditures due to negligence, incompetent help or other conditions; third, the cost of each individual part or piece of every machine is recorded—information that can be advantageously used in computing cost of duplicate parts when needed; fourth, there is a correct tally of material used for both part or machine, and actual cost of each; fifth, an additional feature is that after a complete record of all parts and the machine have been established on the factory cost cards, Figs. 1 and 2, and the department shop order, Fig. 6, the information is all there to facilitate the issuance of any further orders for similar parts.

CHAPTER II

STOCK-KEEPING SYSTEM

In all manufacturing establishments the place in which the most money can be lost or saved is undoubtedly the stock room; for here, in one department, we find all the parts comprised in the product, the smaller tools used in its making, and in some cases, expensive printed and advertising matter. Yet, in nine cases out of ten, this department is placed in some poorly-lighted, ill-ventilated, obscure part of the building and is in charge of a man who has probably secured the position in consequence of a good memory or his inability to become a mechanic, and who is very frequently incompetent, probably due to his being very much underpaid. As assistants, there are usually with him a few boys or old men who cannot be usefully employed in other departments.

The system of stock-keeping explained in this chapter has been tried in various plants and proved to be very successful, not only

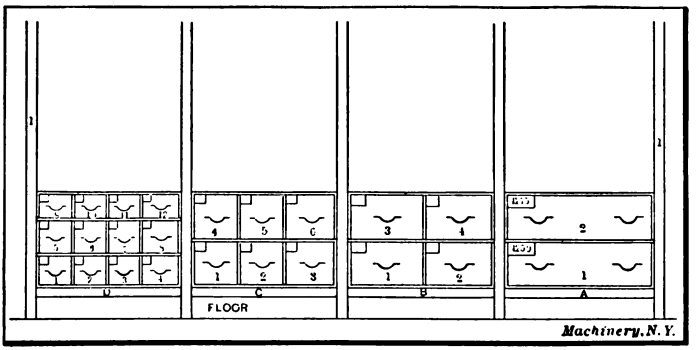


Fig. 1. Elevation of the Arrangement for Keeping Parts used by a Company Manufacturing Small Machines

from a production, but also from a pay-roll, standpoint. It must be understood, however, that the success of any system depends largely on the cooperation of the office and accounting departments with the stock-keeper, and any error or misunderstanding between them should be investigated and settled at once; for frequently, even in the best managed plants, the office is obliged to call on the stock-keeper for information, and his prompt attention facilitates matters.

In a properly systematized plant all the parts entering into the final product should be kept in the stock room and drawn out as desired on orders signed by the proper authority, usually the foreman of the department concerned. This stock may be divided into three classes: finished stock, rough stock and supply stock. Under the

classification "finished stock" are included all the parts which are manufactured in the plant. The rough stock includes all purchased materials such as steel, iron, rough castings, etc. Supply stock constitutes such materials as paint, waste oil, small tools, etc., and at times includes such things as advertising matter, letter-heads, envelopes and office supplies. The first-mentioned of these supplies are frequently included under the "rough-stock" head, but experience shows that by keeping these supplies under a separate heading, better accounting results may be secured. These divisions, of course, may be varied to suit the requirements of the accounting department, but in most cases these three divisions will be found to be sufficient.

It cannot be too forcibly stated that every article in a stock room should be known by a number in addition to its name, and wherever

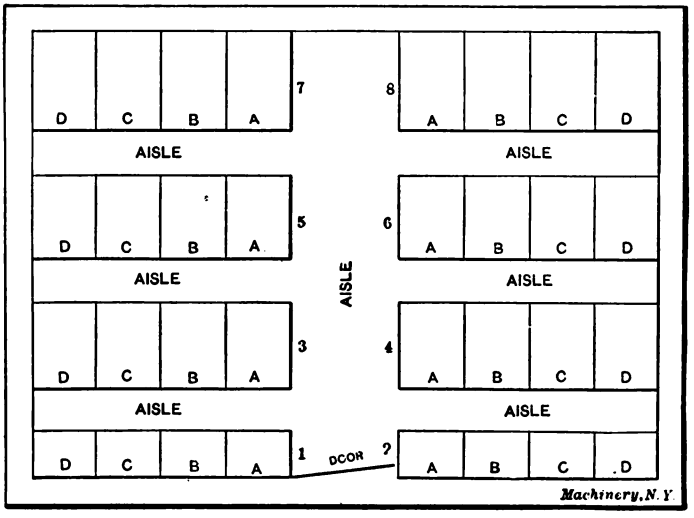


Fig. 2. Plan of Arrangement Shown in Fig. 1, for Keeping Machine Parts

possible that number should appear on the requisition for material. In good manufacturing systems the use of names for parts may be entirely eliminated, numbers being used exclusively, the result being better and quicker service in the filling of orders. The use of letters in designating material, except where absolutely necessary, is to be avoided, although in some cases a letter is placed before or after a number to show the kind or quality of the material. As for example 211A might mean casting; 642B forging; and so on, although a system of numbering may be devised that is equally effective. For instance in a case where the product is a machine consisting of a number of minor assemblies, all numbers ending with 0 would designate an assembled part; 01 a screw; 03 casting, and so on. By such an arrangement a parts-list may be made up and mastered after a little study.

The center of the building seems to be the generally preferred position for the stock room, but the ideal location is at the end of the building, as near the office as possible, for in the former case a considerable drawback arises should it ever become necessary to enlarge this department, as other departments would be more or less inconvenienced. Furthermore, firmer and better structures for holding material may be built at the end of the building.

No drawers or shelving for parts that are in constant use should be more than seven feet above the floor, the space above this being utilized for such parts as are only occasionally called for. In so ar-

Spindle Arm Attachment

4250	Spindle Arm Assm	1	a	1
4251	" " Bearing	1	a	19
4252	" " " Screw	1	a	21
4253	" " " Spring	1	a	27
4254	" " " Nut	3	b	4
4255	" " " Lock	3	b	7
4256	" " Pin (See 4118)	7	a	19
4257				
4258				
4259				
4260	Spindle Gear Assm.	5	a	3

Machinery, N.Y.

Fig. 3. Portion of Parts List

ranging the parts that they may be readily located, an indexing system has been devised which with slight variations may be suited to any special business. Fig. 1 shows the front view of an arrangement used by a plant manufacturing a number of small machines. This room which is about forty feet square is divided through the center by an aisle four feet wide and is sub-divided into sections, tiers, and compartments. The term *section* is applied to the construction on either side of the aisle, that on the right being designated by even numbers and that on the left by odd. These sections are divided into *tiers* which represent spaces between the uprights and are alphabetically lettered to avoid the confusion of numbers. The *compartments* are the

drawers or shelving for holding parts. Figs. 1 and 2 give a general idea of the application of this plan.

Sheet iron or heavy tin is the most practical and durable construction material for drawers, especially for those holding parts which are oiled. These, with a small card-holder and handle, may be obtained at low price, and being easily washed and lighter than wood, facilitate handling. In addition they should be made interchangeable, the tiers being fitted with strips to hold interchangeable boards upon which the drawers can rest. In drawers that are the same width as the tiers (see Fig. 1, 1A1 and 1A2), these strips may be fastened to the sides and will be found to work very satisfactorily.

The arrangement for taking care of the stock having thus been attended to, the application may next be noted. Fig. 3 shows a section

STORES ORDER

ORDER NO. 1437

DELIVER TO 110 DEPT. H DATE 7/2/10 LOT NO. 2

QUAN	DESCRIPTION	NO.	COST PER UNIT	COST TOTAL
100	Parts to Assemble	4250		

FILLED BY	CHECKED BY	O'N STOREKEEPER	FOREMAN
616	712	Smith	Brown

Machinery, N.Y.

Fig. 4. Stock Requisition Slip

of a page of a parts-list in common use. A requisition calls for part 4250 which is shown in parts-list as being located in section 1, tier A, drawer 1 (1A1.) The stock clerk knows that 1 being odd, is located to the left of the main aisle; A being the first letter of the alphabet, is the first tier of section 1; and drawer 1 will be at the bottom of a tier. One company, in mind at present, has its product divided into sections, parts for which are drawn out, assembled and then returned to the stock room and again drawn out combined with other assemblies, completing the finished product. Fig. 4 shows the form of stock requisition slip which is given to the stock clerk, who turns to the card or sheet shown in Fig. 5, looking up the corresponding number, which readily locates the article desired. This order after being filled is checked and forwarded to the office where, after being priced, it is filed against the original order. It is not within the range of this treatise to discuss systems of accounting, but it may be stated that the best results will be obtained where the least time is lost between filling the order and sending it to the accounting department.

In handling steel bars of all shapes, iron pipe may be used in the building structure, and the divisions marked with tin tags.

The stock card, Fig. 6, gives a record of the in-coming and outgoing material; and the stock clerk after making deductions, should see that the amount in stock is above the low mark which is indicated in the upper right-hand corner. As soon as filled these tickets should be forwarded and old cards filed numerically per part number; but, this work should be done by the stock-keeper and not by his clerks. In every case where the ticket is to be forwarded or parts to be ordered, the ticket should be placed on the stock-keeper's desk where a glance at it will at once convey to him a knowledge of the way things stand in regard to this particular article. Every card should be gone over carefully before forwarding on account of arithmetical errors which are always likely to occur; and, if the stock system is

Spindle Arm Assm 4250

PART	QUAN	NAME	SEC	TIER	COMP
4251	1	Spindle Arm Bearing	1	a	19
4252	2	" " " Screw	1	a	21
4253	2	" " " Spring	1	a	27
4254	1	" " " Nut	3	b	4
4255	1	" " " Lock	3	b	7
4256	2	" " " Pin (411F)	7	a	19
4257	1	" Gear Assm	5	a	3

Machinery, N.Y.

Fig. 5. Stock-keeper's Location Card

used in connection with the so-called perpetual stock record system, this is imperative as any difference between card and ledger will cause delay in checking for the inventory.

The most important consideration in the organization of a stock department is the selection of the stock-keeper, who must be a good man even if it be necessary to pay him the highest salary on the roll. This man who has charge of what should be the most valuable department in the plant, should be above the ordinary employe as regards both ability and character, and one who is indifferent or incapable should not be retained. Furthermore he should have sufficient capability to assume full control of his department. By this it is not to be understood that the stock-keeper is to be allowed to adopt his own methods regardless of the prevailing policy of the management, but that he should be strong enough to fill his position without being constantly

called upon to explain errors and accidents, for a man of this type would never be able to manage a department.

Check Systems for Tool-rooms

In order to determine the best system for keeping track of the tools lent to the workmen from the tool store-room, three methods, as outlined in the following, were tried in a well-known shop employing about five hundred hands.

With the first method, each man had a number of checks in his own keeping, and one of these was deposited with the store-keeper for

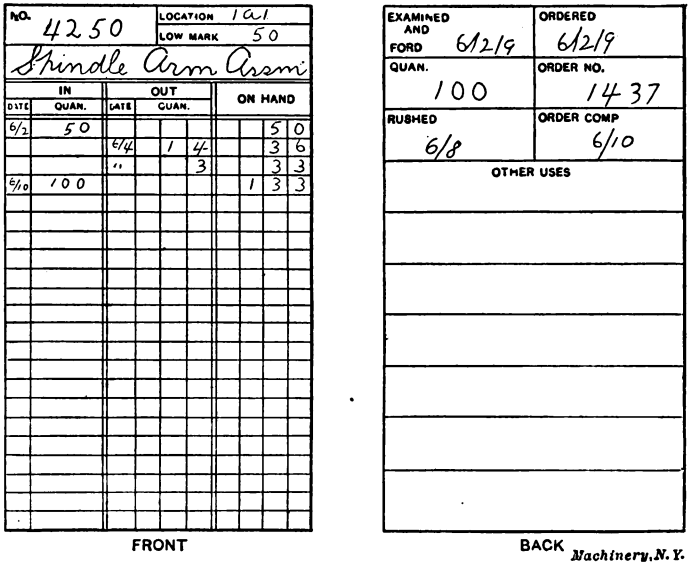


Fig. 6. Card for Recording Stock in the Stock-room

each tool borrowed. This check was hung near the space previously occupied by the tool lent, in the usual manner.

As the foregoing method was somewhat unsatisfactory, all checks were collected from the workmen, and kept on a board in charge of the store-keeper, from which they were removed and hung, as in the first case, when tools were borrowed.

The second method also proved unsatisfactory and was abandoned. Loose printed slips of paper were then distributed in suitable boxes about the works, and each man was obliged to write on a slip his pay roll check number, what tool he required, the date, and his signature. This slip was then handed to the store-keeper in receipt for the tool borrowed, and the slips filed away in card cases, in numerical order, back of guide cards arranged to suit the various classes of tools, such as taps, reamers, cutters, etc. When the tool was returned, the slip was handed back to the man to be destroyed.

The first two methods are the ones commonly used where there is a tool store-room, some firms preferring one, and some the other. The

first method was abandoned by the shop in question after a twelve months' trial, because the men could not, or would not, take care of their checks, and if one of these were lost, there was nothing to prevent its being used by another man, if he found it, for it was impossible for the store-boys to know whether every man handed in the proper check or not. Again, checks would occasionally get misplaced, causing considerable trouble. Various means were taken to prevent these troubles, but without success, and finally the second method was adopted. This was also given a twelve months' trial, and, if anything, proved rather worse than the first, as the store-boys misplaced the checks, omitted to replace them on the board when tools were returned, or, if there was more than one check on the hook, sometimes took off the wrong check. No doubt some of the men contributed to the trouble by losing or mislaying a tool, and then claiming that it had been returned and that the boy had forgotten to replace the check on the board. The third method has proved more successful than either of the other two. Of course, it takes longer to write out the slips, and there is a slight expense for paper, printing, etc., but this expenditure is more than offset by the satisfactory way in which the system works.

Modifications of Check Systems

Some shops have endeavored, with certain additions to the metal check systems, to make them more successful. In one case, a number of checks stamped from one to thirty-one and of a different shape than the other checks, are kept in separate boxes in a drawer and used for each date of the month; they are used for the finer tools only, such as standard plugs, etc. When a man gets a standard plug, for instance, his check is placed on the pin where the tool is kept, and a check with the date of the month is also placed on the same pin, thus showing what day the tool was taken. At the end of the month if the tool is still out, the man having it is looked up and if he still wishes to use the tool, he must first return it to the tool-room; another check is then put on the pin showing that the tool was taken again on the first of the month. By this method the tool-room foreman knows where the tools are on any date of the month, and how long they have been out. No trouble has been experienced with this part of the system thus far.

Another modification makes use of duplicate checks in the following manner. Each man has a number of checks in his own keeping, as before. A check of different shape, with the name and size of tool stamped on it, is placed on a pin near each tool on the shelf or in the drawer. When a man calls for a tool, he gives his check, and, in return, receives in addition to the tool, the check with the name and size of tool on it; it is really an exchange of checks. This system would tend to prevent the men or boys who give out the tools, from placing the wrong check on the peg of some missing tool and holding the wrong man responsible for it, because the man who has the tool also has the check to show for it; furthermore the men sometimes

forget what tools they have out on check, either by lending or misplacing them, and in such a case the check with the name and size of tool on, would be a reminder. This system, in which there is an exchange of checks, is in use and has proved satisfactory.

CHAPTER III

AN EFFECTIVE FOLLOW-UP SYSTEM

The primary consideration in introducing new methods of management, is whether or not an adequate return will be derived from the expenditure involved. Such return may be either direct or indirect, but it must be sufficient to offset both the cost of introducing the new method and the operating and maintenance costs, and still leave the required margin or profit. When the project is of a size which involves a large outlay of money, it is obvious that the most careful study must be given to every detail of the proposed plan.

It is the purpose to outline, in this chapter, a follow-up system for keeping an account of the materials used in a factory engaged in small interchangeable manufacture, and also of the progress made by different orders in passing from department to department in the course of manufacture. This system was introduced to remedy certain evils that are likely to arise in any manufacturing establishment, and the man responsible for it was particularly fortunate in that he was not hindered by considerations of expenditure. This fact is mentioned because, had considerations of expenditure been carefuly weighed before the benefits derived from the change had been demonstrated, it is probable that the new system would have been one of the many useful ideas "adorning the shelf," owing to the large initial and up-keep expenses. It may be mentioned that lack of perception on the part of the management is often responsible for discarding valuable ideas from failure to see the advantages which they possess, and unwillingness to bear the burden of what appear to be unreasonable expenses.

Before explaining the workings of the follow-up system described, it will be of interest to outline briefiy the conditions which were responsible for bringing it about. As previously mentioned, this system was introduced through necessity, and the same may be said of the changes which are made in many industrial establishments. When a factory is engaged in the manufacture of small tools or similar products, turned out in large quantities, a great many letters are received containing the vexing question, "When will you ship?" If these inquiries are not answered promptly and truthfully, the people waiting for the shipment of their orders will often be put to considerable inconvenience, as it is likely that they have planned and laid out their work with such promises of shipment in view. If these promises

are not kept, the orders will frequently be cancelled or repeat orders, at least, will not be received by the manufacturer. It was due to the distrust created among prospective purchasers, through giving evasive answers to inquiries about dates of shipment, and failure to keep promises, which led to the development of this follow-up system. This system is, with some modifications, in use in one of the largest factories of its kind in the United States, and after more than three years' experience, it has demonstrated its ability not only to remedy the evils which previously existed, but also to improve manufacturing conditions, so that the work of the sales department has been made far more efficient.

Benefits of a Follow-up System

The benefits derived from this system may be briefly outlined as follows:

1. It enables the management to tell the date on which any order will be finished and ready for shipment, without having to go out into the different manufacturing departments, and with a minimum expenditure of time.
2. To systematically follow up all work—promised and unpromised from one department to another, and thus receive warning of any delays or mishaps which may occur.
3. To tell at short notice in *which* department *any* order is at *any* time.
4. To tell at equally short notice how long an order has been in any department at a given time, thus making it possible to investigate causes of delay and take steps to remedy them.
5. To find out how many orders a department has on hand, thus making it possible to trace congestion and investigate the cause, *i. e.*, shortage of help, equipment, etc.
6. To afford a means of creating watchfulness on the part of department heads in regard to the time taken in the execution of orders.

As a result, it is impossible for men who are responsible for delays to avoid censure by such time-worn excuses as, "I did not understand it that way," "I mislaid the instructions," "I did not know," etc. As the foremen know that the follow-up system affords a sure method of placing responsibility for any hitch that may arise in the execution of an order, they are quite careful to make investigations on their own account before their superiors have been advised in regard to any delinquency that may have occurred in their respective departments.

To those who are intimately in touch with the details of operating a modern plant, it may seem that any follow-up system is a needless expense, especially if the goods manufactured are of a standard kind (not necessarily size). In most lines of manufacture, however, even standard articles consist of several parts, and in order to turn out the finished product these parts must be finished and made ready for the assembling department long before the supply of finished product has been exhausted. In such cases, a follow-up system is necessary for

tracing the parts of the completed product through the different departments of the factory. Under these conditions, the system can be reduced to its simplest and most inexpensive form, its chief function being to follow up orders, consisting of a limited number of either parts or complete articles, finishing them before the supply is exhausted.

The system has its greatest usefulness, and is, in fact, an absolute necessity in establishments manufacturing small products of many sizes and many kinds, where a great variety of stock must be kept on hand at all times. It will also prove itself of more than ordinary value to an establishment where the departments have been grouped according to operations as is now nearly universally the case. The advantage of this method is that each department is run by an expert who operates the type of machines used in his department according to the most economical method, thus making them produce more and better work than would be possible if the product were made complete in a single department. The saving effected by this method is limited by the loss of time which is involved in moving the work from one department to another, in getting started in each department and by such necessary operations as counting, inspecting, etc. Where a factory is run on this method, without the use of an efficient follow-up system, it will not be long before trouble will be encountered from failure to keep promises in regard to shipment dates, through finding the supply of raw material suddenly exhausted, etc.

Causes of Delay in Finishing Orders

The most important features governing deliveries in any manufacturing plant are the stock and store-rooms for either finished parts or the complete product. Such being the case, it will be well to investigate some of the causes which are responsible for failure to supply these departments with goods in the required quantity and at the specified time. The causes may be outlined as follows:

1. Non-anticipation of large orders and the receipt of a number of small orders at the same time.

2. Shortage of raw material and failure to get in a fresh supply in time to meet existing requirements.

3. Failure to obtain additional equipment in time to meet existing requirements.

4. Lack of system in ordering stock, resulting in failure to issue orders to the factory in time to allow them to be completed before the stock on hand has been exhausted. The department having this work in hand should have intimate knowledge of the capacity of each department, as well as of the entire factory, so that it is possible to foretell exactly the amount of time required to complete any order which is issued.

5. Delays resulting from resetting automatic machinery to adapt it for a new class of work.

6. Delays caused by premium or contract systems where department foremen evade changing machines from one kind of work to

another, in order to secure the greatest possible financial gains for themselves and their men.

7. Failure of the management to see the advantage of investing money in finished material, blanks, castings, and raw material. This condition is most pronounced in times of depression, which are best suited for "stocking up," as labor is cheapest at such times and manufacturing can progress unhampered by special orders that must be completed by a specified time.

Nearly all of these causes of delay were remedied in less than eighteen months by the follow-up system described. This was due to the fact that the system automatically calls attention to conditions responsible for delays, and keeps everyone from the manager and superintendent to the foreman and his assistant, informed of the conditions that have to be met in order for shipments to be made at a specified time. After a careful investigation of the causes of delay outlined in the preceding paragraph, it may be stated that the failure to keep an adequate supply of materials on hand is responsible for the greatest amount of trouble. The other reasons outlined suggest methods of avoiding them, so that little comment is necessary. It will prove worth while in the long run to keep a few surplus machines and a reserve quantity of finished parts, blanks and raw material on hand. This will make it possible to take care of large orders that come in unexpectedly or a number of small orders received simultaneously, without impairing the operation of the factory in any way.

There is no excuse for any plant manufacturing a product for which there is a continued demand, not providing itself with a surplus supply of finished product. It is a conceded fact that the growth of any industry is dependent upon its ability to meet the demands of its customers, both as regards quality and prompt service. The customer scarcely considers whether his order is too large for your establishment or whether there are other orders on hand which must be filled before his receives attention. The result is that the factory which is able to fill orders promptly usually gets the business. The question of quality is taken for granted, and the manufacturer who neglects this feature will find himself unable to meet the keen competition that exists in practically all lines.

Value of Surplus Stock and Equipment

The preceding may be summarized by stating that in order to meet possible demands of customers for immediate delivery, one of two conditions must exist in the factory. The stock-room must either be well filled with finished product or finished parts of which the product consists, so that it is merely a matter of assembling them for prompt shipment, or else the factory must have an equipment large enough to take care immediately of large orders and finish them without delay. The first condition may be fulfilled by issuing orders to the factory in sufficient quantity and far enough ahead to enable the parts to be finished before the supply of stock on hand is exhausted. (It is suggested, in this connection, that when the supply on hand has been

reduced to an amount equal to the number of pieces sold during any previous year, another order for an equal quantity should be issued immediately. The machine and tool equipment should also be large enough to produce such a number of pieces in a year.) While most manufacturers are willing to invest in reserve equipment, they are unwilling to keep a surplus stock of product on hand. It is reasonable to assume that the capital invested in extra equipment provided to meet emergencies is equal at least to that necessary for keeping a sufficient quantity of finished product on hand to meet such emergencies. In most cases, however, the capital invested in finished product is less than that required for a sufficient reserve equipment, and this advantage is further emphasized by the fact that shipments can be made immediately upon the receipt of orders, when the product is on hand in the store-room. In addition, the capital will be turned over more rapidly, as it is not necessary to wait while the product is being

CUSTOMERS ORDER NO.	OUR ORDER NO.	NO. PIECES WANTED	KIND OF TOOLS WANTED	WILL FINISH DATE
1	2	3	4	5
FILLED IN BY OFFICE OR (STOCK DEPT.)	FILLED IN BY STOCK DEPT. BEFORE BEING SENT TO FOLLOW-UP DEPT.			FILLED IN BY FOLLOW-UP DEPT. AND RETURNED TO OFFICE WITH ORIGINAL LET. OF INQUIRY.

Machinery

Fig. 1. Form used to follow up an Inquiry Regarding Date of Shipment

made before it can be shipped on a given order. It seems scarcely possible that this fact can escape the attention of the management of so many manufacturing establishments, especially when the product so "stocked" can generally be produced at less expense than when made under average conditions. The solution is seemingly found in the fact that equipment does not show up on the books in the same way as finished product. In considering this subject, it should also be borne in mind that immediate shipment is a means of adding to the list of satisfied customers, who will send in repeat orders as the result of efficient service.

The Follow-up System

Having thus outlined some of the more important reasons for the use of a follow-up system, and the conditions over which it has control, the system which has many original features, and which has been proved to be more efficient than other systems coming under the author's observation will be described. In order to make the explana-

tion readily understood, certain minor details such as shipping and factory order forms will be omitted. Suffice it to say that the forms in general use for such purposes can be adapted to almost any system with satisfactory results. In starting upon an explanation of the workings of this system, it will be assumed that any inquiry as to the date of shipment of an order is received by the office. This inquiry usually carries the customer's order number, and is generally given a factory order number by which it is known until the order has been completed and shipped. The inquiry is immediately turned over to the stock department with the tag shown in Fig. 1 attached to it. The customer's order number is generally filled in by the office, but in certain cases

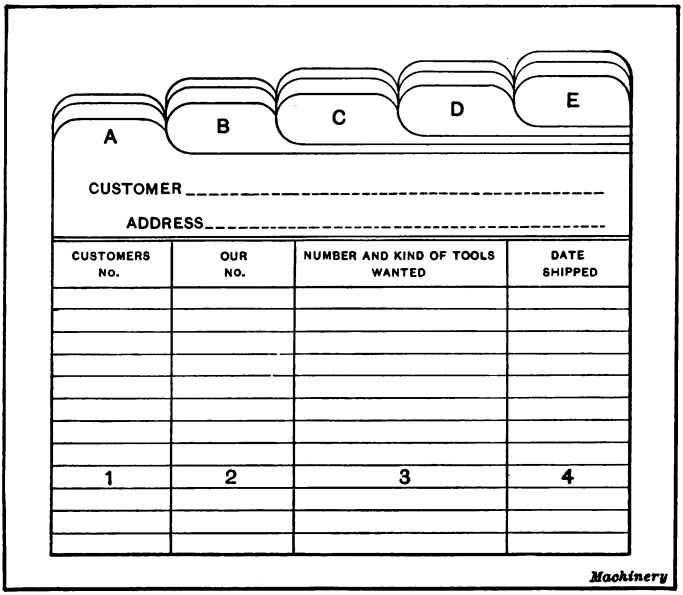


Fig. 2. Card Index kept by Stock Department

where the customer's original order number is on file in the stock department, the tag is left to be filled in when it reaches that point.

The stock department keeps a card index, of the form shown in Fig. 2, on which the factory order number is given opposite the customer's order number in cases where the goods are not in stock and have to be made. If no number appears on the card opposite the customer's order number, it signifies that the goods have already been shipped, the date of shipment being recorded in the column marked, "Date Shipped." If shipment has not been made, which is shown by the fact that no notation appears in column 4, and if no number appears in column 2 it shows that shipment can be made from surplus stock on hand. These cards are indexed according to names, and it will be noticed that one or more cards are used for each customer and that each card takes care of several orders.

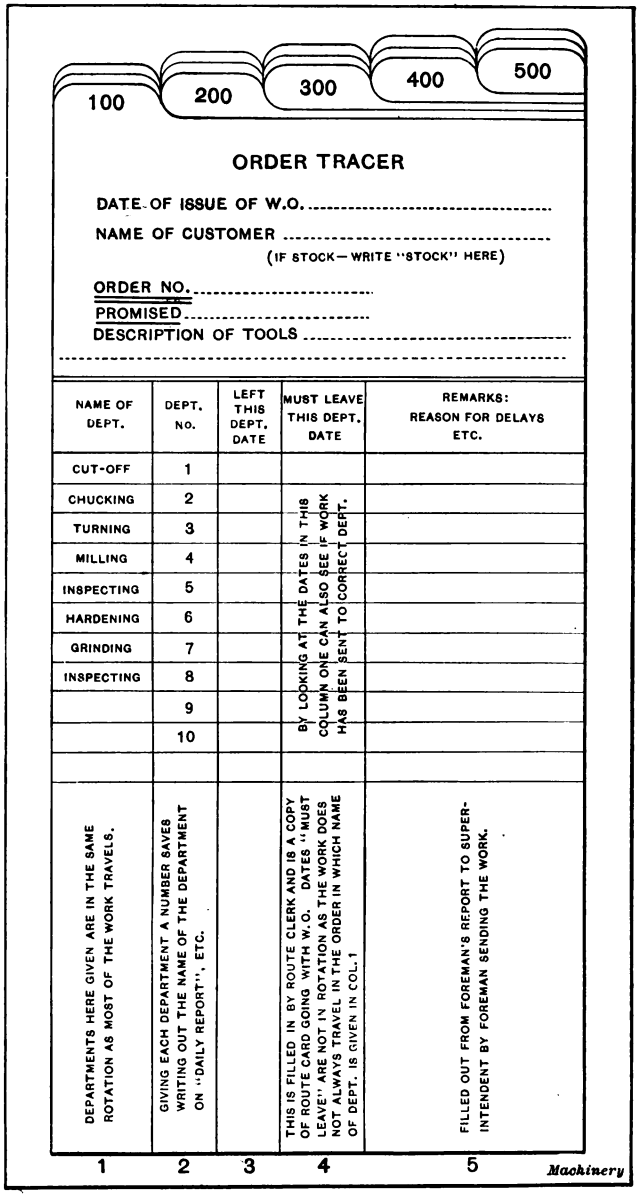

100
200
300
400
500
ORDER TRACER
DATE OF ISSUE OF W.O.
NAME OF CUSTOMER
(IF STOCK—WRITE "STOCK" HERE)
ORDER NO.
PROMISED
DESCRIPTION OF TOOLS
NAME OF DEPT.
DEPT. NO.
LEFT THIS DEPT. DATE
MUST LEAVE THIS DEPT. DATE
REMARKS: REASON FOR DELAYS ETC.
CUT-OFF 1
CHUCKING 2
TURNING 3
MILLING 4
INSPECTING 5
HARDENING 6
GRINDING 7
INSPECTING 8
9
10
BY LOOKING AT THE DATES IN THIS COLUMN ONE CAN ALSO SEE IF WORK HAS BEEN SENT TO CORRECT DEPT.
DEPARTMENTS HERE GIVEN ARE IN THE SAME ROTATION AS MOST OF THE WORK TRAVELS.
GIVING EACH DEPARTMENT A NUMBER SAVES WRITING OUT THE NAME OF THE DEPARTMENT ON "DAILY REPORT", ETC.
THIS IS FILLED IN BY ROUTE CLERK AND IS A COPY OF ROUTE CARD GOING WITH W.O. DATES "MUST LEAVE" ARE NOT IN ROTATION AS THE WORK DOES NOT ALWAYS TRAVEL IN THE ORDER IN WHICH NAME OF DEPT. IS GIVEN IN COL. 1
FILLED OUT FROM FOREMAN'S REPORT TO SUPERINTENDENT BY FOREMAN SENDING THE WORK.
1
2
3
4
5
Machinery

Fig. 3. Order Tracer Card Index kept by Follow-up Department

If the order is special (not in stock and not finished), the inquiry, with the tag shown in Fig. 1 attached to it, is immediately turned over to the follow-up department for answer in regard to the date on which delivery will be made. All of the columns on the tag, shown in Fig. 1, except the last one, have been filled out by the stock department, the date being taken from what is known as the shipping order which includes all details in regard to the items covered by the order.

The follow-up department refers to the order tracer card file, the form of which is shown in Fig. 3. These cards are filed in numerical order, one card being provided for each order number, and show the location of any order in the factory at any specified time. Consequently it is known how far the work has advanced, and also the date

PROMISED

_____ 19 _____

DATE	W. O.	W. O.	W. O.	W. O.	W. O.	W. O.	W. O.	W. O.	W. O.	W. O.	W. O.	W. O.	W. O.	W. O.	W. O.	W. O.	W. O.
1																	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	
11																	
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21																	
22																	
23																	
24																	
25																	
26																	
27																	
28																	
29																	
30																	
31																	

Machinery

Fig. 4. Work Calendar showing Dates on which Orders must be Finished

on which the work will be finished. A record is also kept on this file of any delay that has occurred, the department in which it occurred and the reasons for the delay, reference being made to the superintendent's "Reasons for Delayed Orders" file for this information. Every foreman is required to report to the superintendent at the end of each day's work in regard to every order which could not be finished and sent on to the next department as required by the schedule. When a department foreman receives an order, he marks the number of the order on his work calendar in the column opposite the date on which the operation must be finished by his department. One of these calendars, shown in Fig. 4, is generally hung up in the office of the foreman to afford him a means of looking ahead to make sure that all orders will be finished on time, according to the schedule laid out by the route clerk.

ESTIMATE AND ROUTE CARD
(MUST ALWAYS TRAVEL WITH ORDER IN ENVELOPE)

ORDER NO._____

DESCRIPTION_____

CUSTOMER _____

NAME OF DEPT.	DEPT. No.	ROUTE	MUST LEAVE THIS DEPT. DATE	ACTUAL DATE OF LEAVING DEPT.	REMARKS: REASON FOR DELAYS ETC.
CUT-OFF	1	1			
CHUCKING	2	2			
TURNING	3	5			
MILLING	4	4			
INSPECTING	5	6			
HARDENING	6	7			
GRINDING	7	8			
INSPECTING	8	3			
	9				
	10				
1	2	WHEN OPERATION IS DONE SEND WORK TO DEPT. NEXT IN ROTATION. 3	FILLED OUT BY ROUTE CLERK FROM CAPACITY CARDS. 4	FILLED OUT BY DEPT. FOREMAN. 5	FILLED OUT BY DEPT. FOREMAN. 6

Machinery

Fig. 5. Estimate and Route Card which follows an Order through the Factory

The date on which the work or operation must be completed by any department or foreman will be found on the "Route and Estimate" card shown in Fig. 5. These cards are filled out by the route clerk before the orders for the work are sent out to the factory, and follow the orders for the work from one department to another until the order

is completed. These route cards not only show when each operation must be finished, but also the order in which the work is passed along from department to department, as shown in column 3. Referring to Fig. 5, it will be seen that after the chucking operation is completed in Department 2, the work must be sent to Department 5 for inspection, then to Department 4 for the milling operation, and so on until it is completed. Before the work leaves any department, the actual date of leaving is filled out on the route and estimate card by the foreman of the department. This is done at the same time that the daily

DAILY REPORT

OF ORDERS HAVING TO-DAY LEFT THIS DEPT.

DATE _____

NAME OF DEPT. _____

NAME OF DEPT.	DEPT. No.	DATE OF PROMISE OF ORDER	ORDER NUMBER	ORDER SENT TO DEPT. No.	REMARKS
CUT-OFF	1				
CHUCKING	2				
TURNING	3				
MILLING	4				
INSPECTING	5				
HARDENING	6				
GRINDING	7				
INSPECTING	8				
	9				
	10				
1	2	3	4	5	6

_____
(DEPT. FOREMAN)

Machinery

Fig. 6. Form used by Foremen in making Daily Reports

report, shown in Fig. 6, is filled out, and the foreman receiving the work will be certain to report any errors in these dates to the follow-up department, if the route cards are dated unfavorably to him. This affords a method of checking the accuracy of the daily reports when they are being recorded on the tracer card file by the follow-up clerk.

The plan of having the foremen report any delinquincies or causes for failure to complete an order in accordance with the schedule, is one of the best guarantees that the work will be finished on time. As the superintendent is kept constantly in touch with the progress of each order by this method, he is able to take the necessary steps to prevent

a constant recurrence of delays in any department, and this is largely responsible for the success which has been obtained from the use of this system.

With the data available through the records kept by this system, it is possible to answer inquiries in regard to the date of shipment immediately and with a reasonable degree of accuracy, without having

ROUTE CARD

COLLETS —#2 SCREW MACHINE

ALL SIZES COLLETS FOR THIS MACHINE TAKE SAME ROUTE; ALSO ALL SIZES FOR #3 AND #4 SCREW MACHINE.

ROUTE	DEPARTMENT	No. OF DEPT.	REMARKS
1	CUT-OFF	1	
2	CHUCKING	2	
5	TURNING	3	
4	MILLING	4	
6	INSPECTING	5	
8	HARDENING	6	
	GRINDING	7	
	INSPECTING	8	
THIS COLUMN PILLED IN MADE	OUT IN CASE OF	AND CAN CHANGE IN	BE CHANGED OR NEW CARD EQUIPMENT OR METHODS.
1	2	3	4

Machinery

Fig. 7. Route Card for Collets for No. 2 Screw Machine

to go out into the manufacturing plant for the purpose. It will be seen that the tracer card file, shown in Fig. 3, is the key to the whole situation. As previously mentioned, these tracer cards are made out before the orders go to the factory and are checked every day from the daily reports shown in Fig. 6. The route outlined on the route and estimate card, shown in Fig. 5, is, of course, an exact copy of the route card illustrated in Fig. 7 for the particular class of work which

CAPACITY SHEET—PER HOUR—PER DAY OF 10 HOURS

COLLETS #2 SCREW MACHINE

DEPARTMENTS	CAPACITY-SIZE						REMARKS
	½	⅝	¾	⅞			
CUT-OFF							
CHUCKING							
TURNING							
MILLING							
INSPECTING							
HARDENING							
GRINDING							
INSPECTING							

Machinery

Fig. 8. Capacity Sheet for No. 2 Screw Machine Collets

ORDERS IN PROCESS —PROMISED

COLLETS #2 SCREW MACHINE

SIZE	QUANTITY	ORDER NO.	DATE PROMISED									
			CUT-OFF	CHUCKING	TURNING	MILLING	INSPECTING	HARDENING	GRINDING	INSPECTING		
½												
½												
½												
⅝												
⅝												
⅝												
¾												
¾												
¾												
⅞												
⅞												
⅞												

Machinery

Fig. 9. Sheet giving Record of Orders in Process of Manufacture

is being made. In this connection, it may be mentioned that the routes followed through the factory by many classes of work are practically the same.

Determining the Capacity of the Factory

The capacity sheet, shown in Fig. 8, although not directly connected with the follow-up department, plays an important part in the operation of the factory. These sheets show the capacity of each department for all the different operations which it handles. They are kept in a special loose-leaf binder, so that changes may easily be made in case of the addition of new machinery or methods in any department. The left-hand pages of the sheets kept in this binder enable the route clerk to determine the capacity of any department for a given operation at a glance, and the right-hand pages, shown in Fig. 9, give a record of all the orders in the factory that must be handled by the different classes of tools, the capacities of which are given on the capacity sheets. The dates on which these operations must be completed are recorded so that when a new order is issued an accurate estimate of its date of completion may be made.

The follow-up clerk checks the number of each order which has been passed on to a new department and the departments to which the work was sent from the daily reports, when checking up the tracer cards each morning. In so doing, he finds any discrepancy between the date on which the work was finished and the date when it should have been finished, according to the schedule. He may refer to the superintendent's file to obtain the reason in case of delay.

Although this system may be said to fill all of the requirements of following up the progress of orders through the factory, and keeping them moving according to schedule, it is lacking in certain respects. For example, how can a factory manager or superintendent determine the number of orders that a certain department has on hand at any time from a card index? How are such officials going to find out (without the assistance of a lot of clerical help and a lot of red tape) how long an order has been held in a given department? How are they going to know if promises are kept? For this purpose, the "Follow-up Rack" was designed, of which two sections are shown in Fig. 10, and which the writer believes to be an entirely new feature in follow-up systems.

This rack consists of twelve sections, one being provided for each month in the year, and is used to keep a record of progress of the work in the factory. A small card, of the form shown in Fig. 11, is made out at the same time that the estimate card is made out when an order is sent to the factory. Referring to Fig. 11, it will be seen that one side of this card has spaces for the order number, the name of the customer, the date on which delivery is promised and a description of the product called for by the order. The opposite side shows the different operations that must be performed on the work, the dates when the work should leave the different departments according to the schedule, and the actual dates upon which it did leave these de-

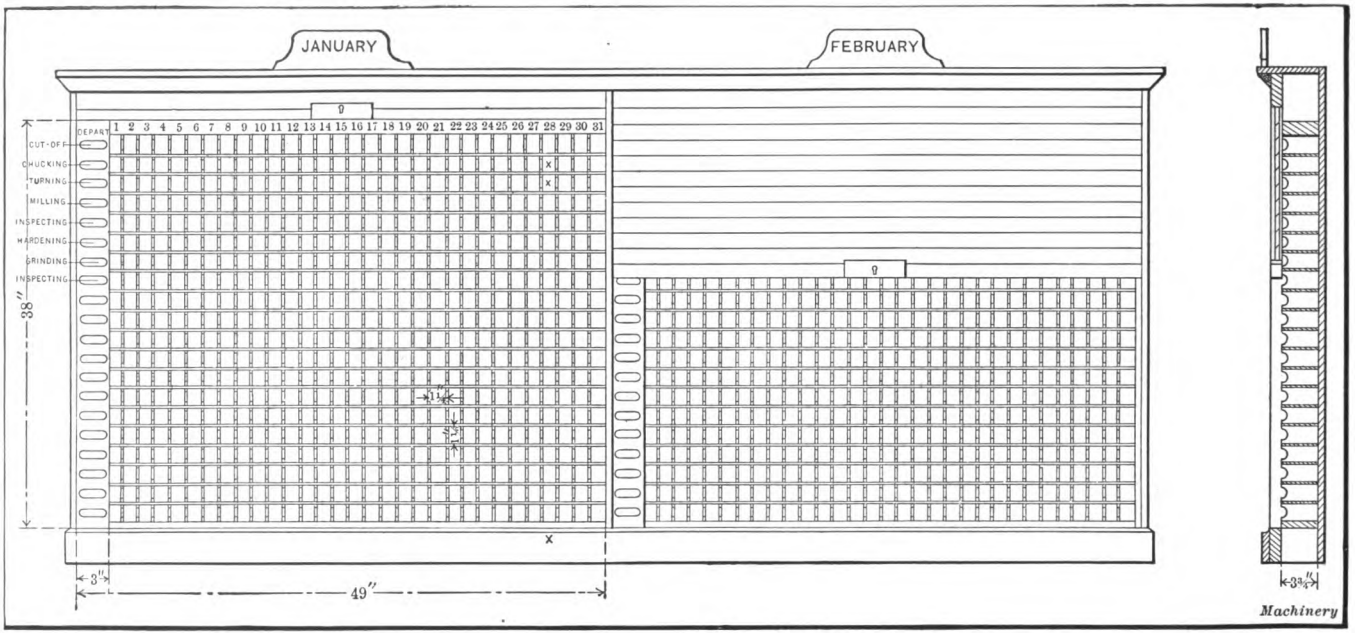


Fig. 10. Follow-up Rack which shows Progress of All Work in the Factory

partments. Fig. 12 shows both sides of the form of card used for stock goods. This card is of a different color from that shown in Fig. 11, which is used for special goods, and the customer's name is omitted. The reverse side is the same as that of the card described in connection with Fig. 11.

To illustrate the purpose of these cards, it will be assumed that Order No. 7001 is received from Jones & Co. for 500 collets on November 2, 1912. After the card is filled out

in Column 2 by the route clerk, at the same time that he is filling out the estimate and tracer card, the clerk refers to the capacity sheet, Fig. 8, and to the promised order sheet, Fig. 9, to find if the order can be completed by January 28, which is the date specified for delivery. He then files the card in the 28th column of the January rack, opposite the department in which the first operation is performed. The card is then moved up or down in this column, keeping it opposite the department to which the work has been transferred until the work is completed. The proper location for the card is found from the daily report, which not only indicates to which department the work has been sent, but also the date on which the order was promised for

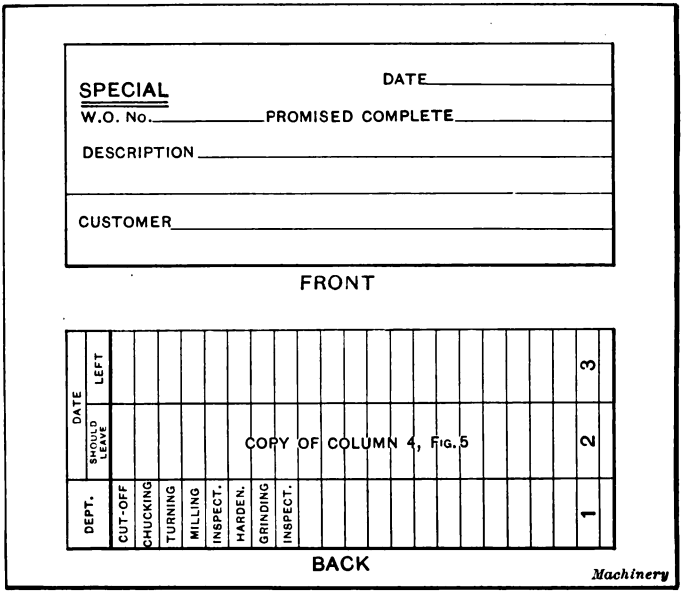


Fig. 11. Follow-up Rack Card for Special Orders

delivery. This enables the position of the card in the rack to be immediately found, and also the date on which it was promised.

The card remains in the 28th column until the order is completed, after which it can either be thrown away or filed for future reference. This arrangement enables one to see at a glance just how many orders are promised to be completed, and if they are not finished on time this is immediately indicated by the appearance of the cards in the rack for dates already passed. This naturally causes everyone concerned to push the work along with all possible speed, and constitutes a gage of efficiency for both the department foremen and the follow-up department. This rack also makes it possible to look ahead, and if there appears to be any doubt in regard to a given order being unfinished by the specified date, there is ample time to take the necessary steps to avoid such a contingency.

All twelve racks are arranged in a single horizontal row, and by looking along the row it is possible to form an accurate estimate of how many orders a given department has on hand at any time, which could not otherwise be easily done. By looking at the back of the card, it is possible to see just when the work should have been completed in a given department, and when it actually was finished, the backs of the cards being filled out by the follow-up clerk from the daily reports sent in by the foremen. These data are especially valuable in cases where delay has occurred, as the department where the delay occurred can be instantly located without having to refer to the order tracer file.

It will readily be seen that the capacity records involve a good deal of expense, not only in getting them up but in keeping them

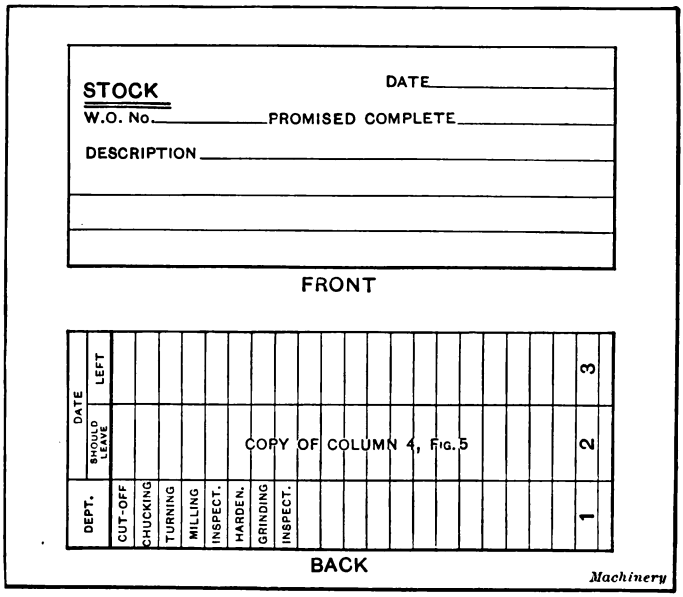


Fig. 12. Follow-up Rack Card for Stock Orders

up-to-date. It has been found however, that these records are an actual necessity, whether a follow-up system is used or not, and consequently this expense cannot justly be entered on the books against the follow-up system. The advantages secured through the follow-up system and follow-up rack which have been described are far-reaching in their results. The heads of manufacturing companies have not generally much time for details, and the use of this system keeps them informed of nearly all the conditions in the plant that are of vital importance. Very little time is required to secure this information, and, best of all, they can determine just what these conditions are without spending valuable time in going about the factory. Figures and data are often misleading and errors or unintentional deceptions

entering into the reports of subordinates are very frequently responsible for serious complications. Where this system is used, however, such deceptions are impossible and the management is thus protected from both deserved and undeserved criticism of customers, which leads to the loss of future orders. Hence, this follow-up system may be said to constitute one of the most productive non-productive departments in any manufacturing establishment.

CHAPTER IV

ROUTING SYSTEM IN A MACHINE TOOL SHOP

Of shop systems, like books, there is no end, and again like books, there are good and bad systems. Any shop system must be judged by what it accomplishes and the cost of its administration. The simpler a system, other things being equal, the better it is when judged from the practical man's point of view. The following system of routing work through a machine shop is that used in the building of horizontal boring machines by the Lucas Machine Tool Co., Cleveland, Ohio, and is commended for its simplicity and the complete control and knowledge of the progress of work through the shop.

The detail drawings are made on sheets 19½ by 26 inches. The sheets are divided into sections, the size varying according to the size of the parts shown. The largest number of divisions of the sheet is sixteen, these being obtained by three horizontal and three vertical lines. This size is used only for the small simple details that can be clearly delineated in the available space. In all, there are five sizes of divisions up to and including one half the sheet. The scheme is illustrated in part in Fig. 1. At the bottom, space is reserved for the operation numbers and records of progress.

Two blue-prints are made of each group of details in the drawing room and issued for each lot of twenty-four machines. One print is made of paper and is kept in a binder in the shop office. The other print is made on cloth and is cut apart, making as many individual prints as there are separate details on the sheet. These are punched at the top and provided with a ring to which is attached a routing tag. The routing tag is filled out in the shop office and sent into the shop with its blue-print to accompany the parts until finished and delivered to the assembling floor or the store-room.

For the purpose of illustration the 4-pitch 23-tooth first driving bevel gear has been chosen. This detail, shown on the sheet Fig. 1, is shown detached in Fig. 2 with its routing tag attached. The symbol of this part on the drawing is 32—139, in a circle. The first number is the machine number and the second is the pattern number, in case the piece is a casting. Each operation for each piece on the sheet

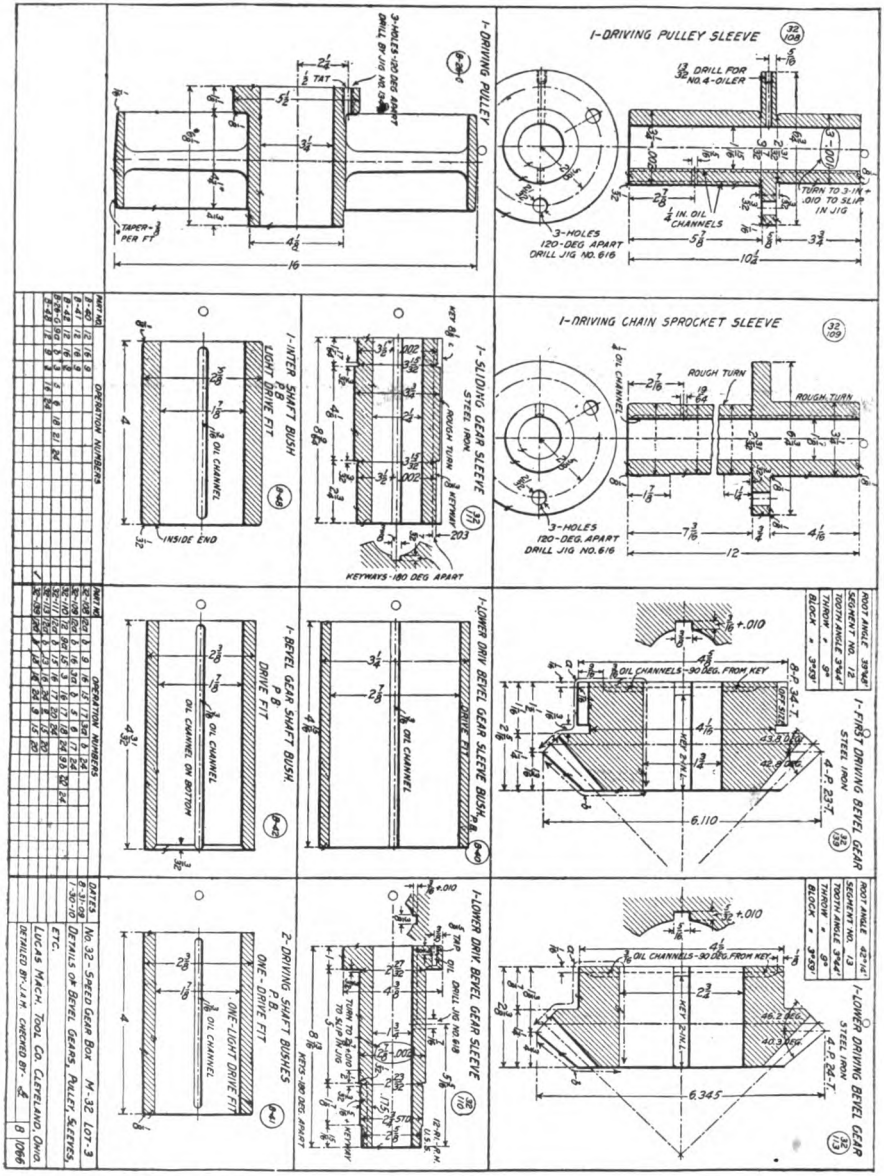


Fig. 1. Detail Drawing showing Operation Numbers and Record of Progress

is designated in the operation sheet at the bottom of Fig. 1, in the spaces opposite the part symbol. The operations on the chosen piece are 12-a, 12-b, 13, 16, 24, 9, 15 and 20, these being "turret chuck" (a and b), "gear cutter," "keyseater," "store-room," "lathe," "milling ma-

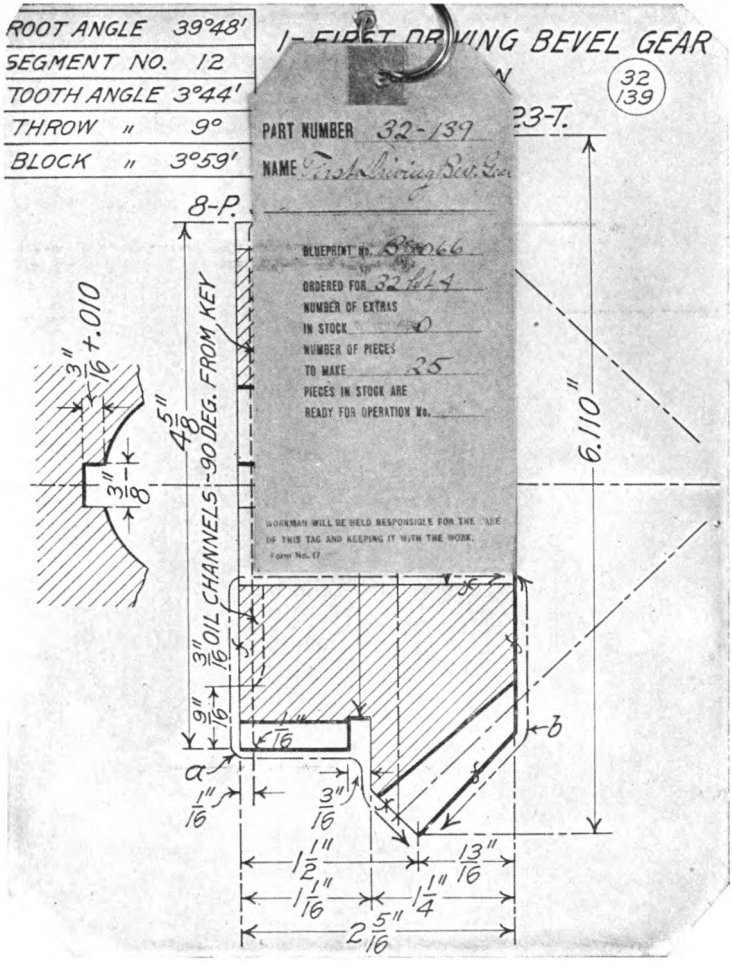


Fig. 2. Detached Detail Drawing with Routing Tag

chine," and "fitting" as will be seen in the accompanying schedule of operation numbers.

It will be noted that this schedule gives the name of the operation in some cases, but in more it gives the name of the machine. The reason for this is that the individual operations on the lathe, milling machine, etc., are minutely specified in separate lists that accompany the routing tag and blue-print when required to follow out the order

that has been determined in the planning department. These lists of operations are typewritten and blue-printed, and are pasted on the back of the shop blue-prints.

J. T. No 668

ORDER NO. 32 Lot 4 PIECE NO. 32-139

OPERATION 12 a-b

NO. PCS. ORDERED 25 NO. PCS. FINISHED

WORKMAN Geo. Buchner

NO. 1 CARD DATE 15

DATE	MORNING		AFTERNOON		OVERTIME	
	IN	OUT	IN	OUT	IN	OUT
16						
1-17						
2-18						
3-19						
4-20						

Fig. 3. Top Portion of a Cost Card

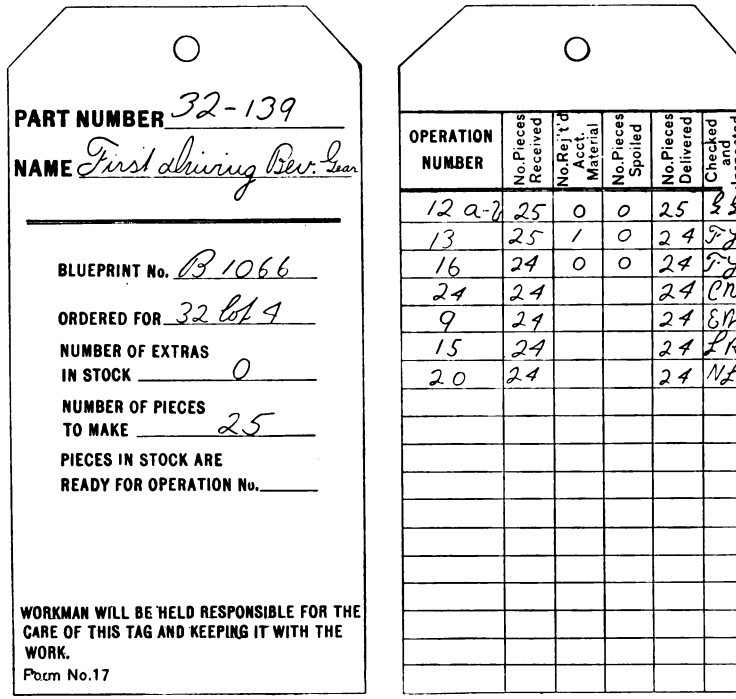
Operation Numbers

1.—Planing
2.—Boring Machine
3.—Drilling Machine
4.—Helping
5.—Cleaning Castings
6.—Painting (including filling and rubbing)
7.—Cutting off
8.—Centering
9.—Lathe
10.—Lo-swing Lathe
11.—Turret Bar
12.—Turret Chuck
13.—Gear Cutter
14.—Thread Milling Machine
15.—Milling Machine
16.—Keyseater
17.—Grinder
18.—Polishing
19.—Scraping
20.—Fitting
21.—Miscellaneous hand work
22.—Erecting
23.—Inspecting
24.—Store Room
25.—Graduating
26.—Spindle Boring Machine
27.—Auto. Turret Machine

The first operation on the bevel gear blank is chucking in the Gisholt turret lathe and performing operation "a." This operation is boring, facing and turning the surfaces designated by the line *a* in the drawing, which starts in the bore and terminates at the outer angle of the tooth section. This line is broken, the break being one short dash. One short dash indicates that it is the first operation. The second operation "b" is indicated on the drawing by another broken line *b*, the break consisting of two short dashes. Of course, the operator on the turret lathe does not change from one operation

to the other on each piece. He does one operation on each piece first and then changes his chuck and tools to do the second operation, and so on.

When the lot of castings and the routing tag are delivered to the turret lathe, a check mark is made by the clerk on the shop office drawing, opposite the symbol. This mark shows that work has been started on these parts. Further records are made from the cost cards, a sample of which is shown in Fig. 3. The cost cards are of the regular form supplied by the International Time Recorder Co. and are stamped in a time recording clock when the job is started



PART NUMBER 32-139

NAME First driving Rev. Gear

BLUEPRINT No. B 1066

ORDERED FOR 32 bal 4

NUMBER OF EXTRAS IN STOCK 0

NUMBER OF PIECES TO MAKE 25

PIECES IN STOCK ARE READY FOR OPERATION No.

WORKMAN WILL BE HELD RESPONSIBLE FOR THE CARE OF THIS TAG AND KEEPING IT WITH THE WORK.

Form No.17

OPERATION NUMBER	No. Pieces Received	No. Rej't'd Acct. Material	No. Pieces Spoiled	No. Pieces Delivered	Checked and Inspected
12 a-b	25	0	0	25	EF
13	25	1	0	24	FJ
16	24	0	0	24	FJ
24	24			24	CR
9	24			24	ER
15	24			24	LR
20	24			24	NL

Figs. 4 and 5. Front and Back of Routing Tag

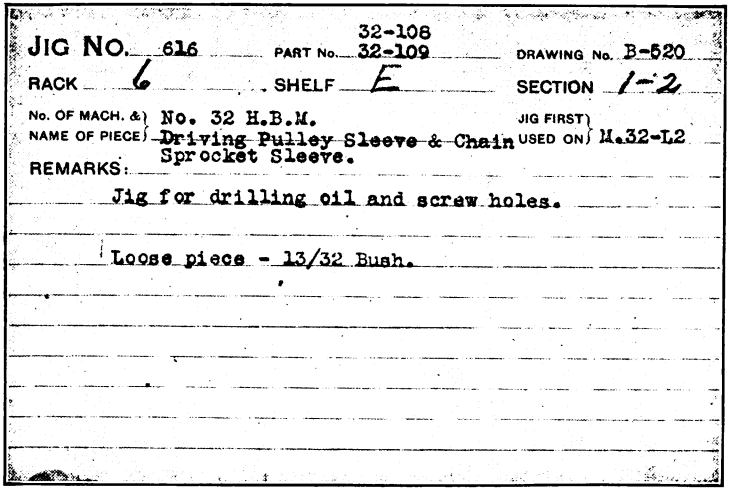
and when completed. They are partly filled out by the shop office clerk, the order number, piece number, operation and number of pieces being the items entered. The cards then go to the foreman who keeps them in a card rack with index tab cards to designate the various operations. Thus there will be cards for practically all the operations enumerated on the schedule of operations.

The turret lathe operator who machined the bevel gear blanks was charged with twenty-five pieces, an extra piece being supplied to replace any casting found defective or spoiled. When he finishes operation 12-a and 12-b, the time of completion is stamped in the time recorder, and the card is turned in to the foreman, who then gives the

workman another job, and the cost card for the operation is stamped in the "In" column. The cards for completed operations are collected each morning, and the completed operations are marked off on the shop office blueprints as indicated in Fig. 1 for operations 12-a and 12-b. The same is being done for all the other parts on this sheet and on the other sheets for the lot of machines going through.

When the turret lathe man completes the lot of bevel gear blanks and so reports to his foreman, the report means to the shop office that the lot has been delivered to the machine for the next operation. An order is not considered complete until the delivery is made.

The next operation in this case is gear cutting. Twenty-five turned and bored blanks are delivered to the gear cutting department together with the routing tag and blue-print, Fig. 2. The operator to whom they are turned over stamps the time of beginning in the "In"


JIG NO. 616 PART No. 32-108 32-109 DRAWING No. B-520

RACK 6 SHELF E SECTION 1-2

No. OF MACH. & NAME OF PIECE No. 32 H.B.M. Driving Pulley Sleeve & Chain Sprocket Sleeve. JIG FIRST USED ON M.32-L2

REMARKS: Jig for drilling oil and screw holes.

Loose piece - 13/32 Bush.

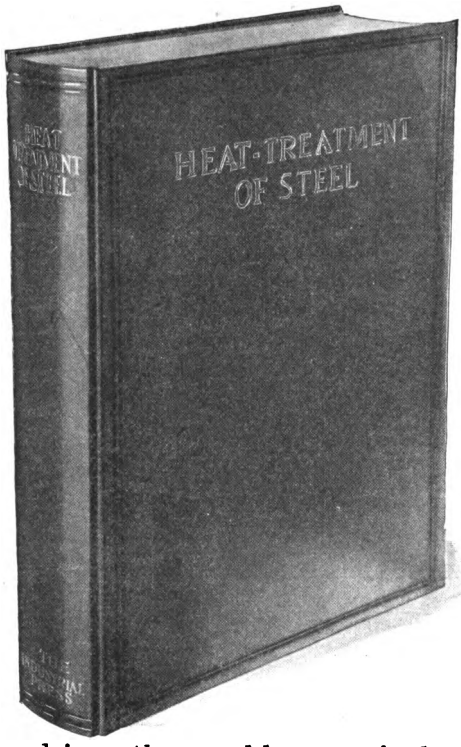
Fig. 6. Sample Index Card Showing Location of a Jig in the Tool-room

column of a cost card filled out for operation 13, and when the lot is completed the time is stamped in the "Out" column as before. In this case one blank was found defective when cut and twenty-four perfect gears were turned over to the keyseater for operation No. 16. The next morning the cost card went into the shop office and operation 13 was checked off on the shop office record blue-print.

The orders for castings also originate in the drawing office, and the prints are not issued to the shop office until the castings are delivered by the foundry. The drawings are made to convey all necessary instructions to the workmen. Thus when parts are to be drilled or bored in jigs, the jig number is given on the drawing. For example, the driving pulley sleeve and driving chain sprocket sleeve, symbols 32—108 and 32—109, are drilled in jig No. 616. This jig will be found in the tool-room in rack 6, on shelf E, in section 1—2. The description of the jig and location are given on a card, Fig. 6, kept in a card index in the tool-room.

From this outline it will be understood that a constant record is available in the shop office which shows from day to day the progress of work on any lot of machines and the location of all parts. It also shows the number of parts spoiled and indicates on what operation they were spoiled. The costs can be calculated for a machine or lot of machines in any stage of construction. The system is much more quickly comprehended than described, and its simplicity is shown by the fact that one clerk attends to all its details after receiving the blue-prints from the drawing office.

Heat-Treatment of Steel



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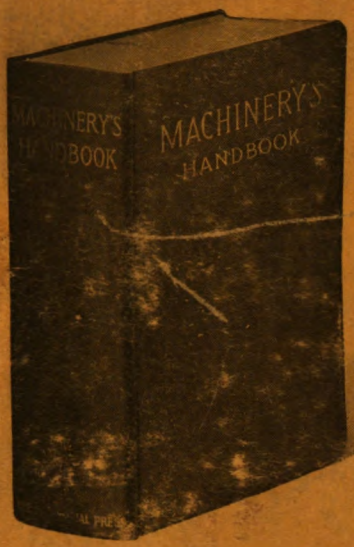

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